Examiners Amended Claims

WE CLAIM:

1. A method for correcting the range and deflection errors in an unguided spin or fin stabilized spinning projectile, comprising:

determining deviations of the spinning projectile from a desired ballistic trajectory in a downrange dimension and a crossrange dimension; and

repeatedly deploying and stowing at least one aerodynamic surface on the spinning projectile forming partial roll cycles that develop a sequence of rotational moments, said spinning projectile's gyroscopic inertia reacting to said sequence of rotational moments to cause a precession of the projectile at a angle to the plane of the average rotational moment creating body lift that iteratively nudges the spinning projectile in said crossrange and downrange dimensions to move the projectile to its desired ballistic trajectory.

2. The method of claim 1, wherein the aerodynamic surface is deployed and stowed within one roll cycle of the projectile to form the partial roll cycle.

3. cancelled

4. The method of claim 1, wherein the projectile has a low spin rate so that the projectile precesses in the same plane as the average rotational moment.

5. The method of claim 1, wherein the projectile has a high spin rate so that the projectile precesses in a plane orthogonal to the average rotational moment.

6. The method of claim 1, further comprising:

launching the spin stabilized projectile on the ballistic trajectory according to a firing table for the same unguided projectile.

7. The method of claim 1, wherein the aerodynamic surface has no effect on the ballistic trajectory of the projectile when stowed.

8. The method of claim 1, wherein the aerodynamic surface is deployed at a fixed angle of attack in a predetermined fully deployed position.

9. The method of claim 1, wherein the aerodynamic surface is moved between only a fully deployed position and a stowed position.

10. The method of claim 1, wherein the determination of deviations from the ballistic trajectory and the intermittent deployment of the aerodynamic surface are continuous-to-target.

11. The method of claim 1, wherein the determination of deviations from the ballistic trajectory and the intermittent deployment of the aerodynamic surface are windowed-to-target.

12. The method of claim 11, wherein the aerodynamic surface is repeatedly deployed and stowed in a first window soon after launch to correct for deviations in the crossrange dimension, in a second window soon after the projectile passes apogee to correct for deviations in the downrange dimension, and in a third window at a time-to-target to correct for deviations in the crossrange and downrange dimensions.

13. The method of claim 1, wherein the aerodynamic surface is deployed and stowed by energizing a voice coil.

14. A 2-D corrector for correcting the range and deflection errors in an unguided spin or fin stabilized spinning projectile, comprising:

at least one aerodynamic surface on the projectile moveable between stowed and deployed positions;

a deployment mechanism for moving the aerodynamic surface between said stowed and deployed positions;

a receiver for receiving the position of the projectile; and

a flight computer that determines deviations from a ballistic trajectory in a downrange dimension and a crossrange dimension and controls the deployment mechanism to repeatedly deploy and stow the at least one aerodynamic surface on the

spinning projectile forming partial roll cycles that develop a sequence of rotational moments, said spinning projectile's gyroscopic inertia reacting to said sequence of rotational moments to cause a precession of the projectile at an angle to the plane of the average rotational moment creating body lift that iteratively nudges the spinning projectile in said crossrange and downrange dimensions to move the projectile to its ballistic trajectory.

15. The 2-D corrector of claim 14, wherein said at least one aerodynamic surface includes a pair of pivot mounted canards.

16. The 2-D corrector of claim 14, wherein the aerodynamic surface has no effect on the ballistic trajectory of the projectile when stowed.

17. The 2-D corrector of claim 14, wherein the aerodynamic surface is deployed at a fixed angle of attack.

18. The 2-D corrector of claim 14, wherein the aerodynamic surface is moved between a fully deployed position and a stowed position.

19. The 2-D corrector of claim 14, wherein the deployment mechanism comprises:
A voice coil, and
A permanent magnet on each of said at least one aerodynamic surface.

20. The 2-D corrector of claim 19, wherein the deployment mechanism further comprises a centripetal spring that substantially offsets a centrifugal force on the aerodynamic surface caused by the rotation of the projectile.

21. The 2-D corrector of claim 20, wherein the deployment mechanism further comprises a deployment spring that is unlocked if the rotation of the projectile falls below a predetermined rate to partially offset the centripetal spring force.

22. The 2-D corrector of claim 14, wherein the aerodynamic surface, deployment mechanism, receiver and flight computer are integrated in a fuze kit for use with a

projectile.

23. The 2-D corrector of claim 14, wherein the aerodynamic surface is deployed and stowed within one roll cycle of the projectile to form the partial roll cycle.

24. cancelled

25. The 2-D corrector of claim 14, wherein the projectile has a low spin rate so that the projectile precesses in the same plane as the average rotational moment.

26. The 2-D corrector of claim 14, wherein the projectile has a high spin rate so that the projectile precesses in a plane orthogonal to the average rotational moment.

27. The 2-D corrector of claim 14, wherein the spin stabilized projectile is launched on the ballistic trajectory according to a firing table for the same unguided projectile.

28. The 2-D corrector of claim 14, wherein the flight computer determines deviations from the ballistic trajectory and repeatedly deploys and stows the aerodynamic surface continuous-to-target.

29. The 2-D corrector 14, wherein the flight computer determines deviations from the ballistic trajectory and repeatedly deploys and stows the aerodynamic surface windowed-to-target.

30. The 2-D corrector of claim 29, wherein the aerodynamic surface is repeatedly deployed and stowed in a first window soon after launch to correct for deviations in the crossrange dimension, in a second window soon after the projectile passes apogee to correct for deviations in the downrange dimension, and in a third window at a time-to-target to correct for deviations in the crossrange and downrange dimensions.

31. A modified fuze kit for use with a spin or fin stabilized spinning projectile, comprising:

a fuze kit;

at least one aerodynamic surface on the fuze kit moveable between stowed and deployed positions;

a deployment mechanism for moving the aerodynamic surface between said stowed and deployed positions;

a receiver for receiving the position of the projectile; and

a flight computer that determines deviations from a ballistic trajectory in a downrange dimension and a crossrange dimension and controls the deployment mechanism to repeatedly deploy and stow the at least one aerodynamic surface on the spinning projectile forming partial roll cycles that develop a sequence of rotational moments, said spinning projectile's gyroscopic inertia reacting to said sequence of rotational moments to cause a precession of the projectile at an angle to the plane of the average rotational moment creating body lift that iteratively nudges the spinning projectile in said crossrange and downrange dimensions to move the projectile to its ballistic trajectory.

32. The modified fuze kit of claim 31, wherein the aerodynamic surface is deployed at a fixed angle of attack.

33. The modified fuze kit of claim 31, wherein the deployment mechanism comprises:

A voice coil, and

A permanent magnet on each of said at least one aerodynamic surface.

34. The modified fuze kit of claim 33, wherein the deployment mechanism further comprises a centripetal spring that substantially offsets a centrifugal force on the aerodynamic surface caused by the rotation of the projectile.

35. The modified fuze kit of claim 34, wherein the deployment mechanism further comprises a deployment spring that is unlocked if the rotation of the projectile falls below a predetermined rate to partially offset the centripetal spring force.

36. The modified fuze kit of claim 31, wherein the aerodynamic surface is deployed and stowed within one roll cycle of the projectile to form the partial roll cycle.

37. cancelled

38. The modified fuze kit of claim 31, wherein the projectile has a low spin rate so that the projectile precesses in the same plane as the average rotational moment.

39. The modified fuze kit of claim 31, wherein the projectile has a high spin rate so that the projectile precesses in a plane orthogonal to the average rotational moment.

40. The modified fuze kit of claim 31, wherein the flight computer determines deviations from the ballistic trajectory and repeatedly deploys and stows the aerodynamic surface continuous-to-target.

41. The modified fuze kit of claim 31, wherein the flight computer determines deviations from the ballistic trajectory and repeatedly deploys and stows the aerodynamic surface windowed-to-target.

42. The modified fuze kit claim 41, wherein the aerodynamic surface is repeatedly deployed and stowed in a first window soon after launch to correct for deviations in the crossrange dimension, in a second window soon after the projectile passes apogee to correct for deviations in the downrange dimension, and in a third window at a time-to-target to correct for deviations in the crossrange and downrange dimensions.

43. The method of claim 13, wherein a centripetal spring substantially offsets a centrifugal force on the at least one said aerodynamic surface caused by the rotation of the projectile.

44. A method for correcting the range and deflection errors in an unguided spin or fin stabilized spinning projectile, comprising:

determining deviations of the spinning projectile from a desired ballistic trajectory in a downrange dimension and a crossrange dimension;

energizing a voice coil to intermittently deploy and stow at least one aerodynamic surface on the spinning projectile to develop a rotational moment, said spinning projectile reacting to said rotational moment to create body lift that nudges the spinning projectile in said crossrange and downrange dimensions to move the projectile to its desired ballistic trajectory;

using a centripetal spring to substantially offset a centrifugal force on the at least one said aerodynamic surface caused by the rotation of the projectile; and

unlocking a deployment spring if the rotation of the projectile falls below a predetermined rate to partially offset the centripetal spring force.

45. cancelled

46. The method of claim 1, wherein the at least one aerodynamic surface is deployed at precise on positions in each roll cycle and stowed at precise off positions in each roll cycle to develop the rotational moment.

47. The method of claim 1, wherein the at least one aerodynamic surface is deployed within a single quadrant of each roll cycle.